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NEW EVIDENCE THAT THE RECTAL VALVE IS AN ANATOMICAL FACT.

(ILLUSTRATED.)

BY

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NEW EVIDENCE THAT THE RECTAL VALVE IS AN ANATOMICAL FACT.

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[Illustrated (*) and written for MATHEWS' MEDICAL QUARTERLY.]

I submit the accompanying photographic reproductions as documentary proof of a fact.

Clinical observation convinces me of the necessity of recognition of the semilunar valves as the chief feature of the rectum proper. The unsatisfactory methods of tactile examination by hand or by sound, and the impossibility heretofore of a complete inspection of this organ, as well as the illogical manner in which necroscopic investigation has been made, very easily explain how there could have occurred a protracted and eloquent dispute concerning the anatomy of the rectal ampulla.

The practical surgeon feels the necessity of knowing positively whether there are or are not in the rectum normal obstructions of the nature of these under discussion. If it be proven that these obstructions exist, it will then be imperative that he abandon a method of diagnosis almost universally practiced, and it will also be necessary that he modify his methods of treatment of certain lesions; possibly, too, a new point of view may be afforded from which to study congenital malformations of the rectum.

A quarrel which is so archaic, so involved, and in which there is such multiplicity of contradiction concerning a matter of scientific interest, can not with proper understanding and with perfect fairness be resumed, in however peaceful a spirit it be undertaken, without the preliminary exact quotation of the expressed opinion of the distinguished workers in this field. I have therefore taken the liberty of making the following quotations and of emphasizing by means of italics such parts as are disqualified or disputed by the evidence which I have found.

Houston,† 1830, writes: "In the natural state the tube of the gut does not form, as is usually conceived, one smooth uninter-

*I am indebted to Dr. C. M. Thruston for very great assistance in the preparation of the specimens and for the drawing of the microscopical appearance of the valve. Mr. Theodore Endean made the photographs.

† Dublin Hospital Reports, 1830, Vol. V, page 158. Hodges & Smith, College-Green, Dublin.

rupted passage, devoid of any obstacles that might impede the entrance of bougies; it is, on the contrary, made uneven in several places by certain valvular projections of its internal membrane, which, standing across the passage, must frequently render the introduction of such instruments a matter of considerable difficulty. Cloquet and some other anatomical writers have made a cursory allusion to this condition of the membrane; but all the authors who have treated of diseases of the rectum appear to have wholly overlooked it.

"The valves exist equally in the young and in the aged, in the male and in the female; but in different individuals there will be found some varieties as to their number and position. Three is the average number, though sometimes four, and sometimes only two are present in a marked degree. The position of the largest and most regular valve is about three inches from the anus, opposite to the base of the bladder. The fold of next most frequent existence is placed at the upper end of the rectum. The third in order occupies a position midway between these, and the fourth, or that most rarely present, is attached to the side of the gut, about one inch above the anus.

"The form of the valves is semilunar; their convex borders are fixed to the sides of the rectum, occupying in their attachments from one third to one half of the circumference of the gut. Their surfaces are sometimes horizontal, but more usually they have a slightly oblique aspect, and their concave, floating margins, which are defined and sharp, are generally directed a little upward. The breadth of the valves about their middle varies from a half to three quarters of an inch and upward in the distended state of the gut. Their angles become narrow, and disappear gradually in the neighboring membrane. *Their structure consists in a duplicature of the mucous membrane, inclosing between its laminæ some cellular tissue, with a few circular muscular fibers. The only method by which the condition of these valves in the distended state of the rectum can be displayed is that of filling and hardening the gut with spirit previous to being disturbed from its lateral connections.* By the ordinary procedure of distending it after removal from the body the valves are made to disappear. Their presence may likewise be ascertained in the empty state, if looked for soon after death, and before the tonic contraction of the gut has subsided.

"They will be found to overlap each other so effectually as to require considerable maneuver in conducting a bougie or the finger along the cavity of the intestine."

Chadwick,* 1878, discussing this subject, says: "Hyrtl, in his treatise on Topographical Anatomy, devotes three pages to the consideration of what he designates as the *Sphincter Ani Tertius*. From his description the only inference is that Hyrtl has generally found a bundle of muscular fibers so encircling the rectum as to exercise the function of a sphincter, at least when the other sphincters are for some reason inoperative. On inflating recta, however, in accordance with the direction given by him, it is rather surprising to discover that no such annular constrictions appear. At the point of the rectum designated by him is, nevertheless, observable a semicircular constriction of the rectum confined to the anterior wall; corresponding to this, but an inch or more higher up, is always seen a second semicircular constriction affecting the posterior wall only. If, now, the rectum be cut open, and its mucous membrane dissected off, as directed by Hyrtl, each of these two constrictions may be demonstrated to consist, as he says the 'third sphincter' does, of an agglomeration of the circular muscular fibers of the rectum. I am able to show you seven recta taken from dissecting-room subjects, from which we dissected off the mucous membrane after cutting them open longitudinally. In all of these you can not fail to find corroboration of my statements in the presence of two distinct masses of circular fibers each encircling about half the circumference of the canal.

"If, now, a mass of feces be supposed to advance through the rectum following the sinuosities, it is evident that these bundles of fibers, when not in active contraction, would present scarcely any obstacle to its progress. It is further noticeable that these partial constrictions of the canal differ only in degree from the constrictions visible in the higher segments.

"At about two and a half inches from the anus the finger encounters a confused mass of folds through which the continuance of the canal can only be discovered by considerable burrowing. Here an annular constriction, diminishing the lumen by about one half, seems to be felt.

"If, now, the rectum be distended with water, the finger will

*Transactions of the American Gynecological Society, 1878, Vol. II, page 43. Houghton, Osgood & Company, Cambridge.

Fig. I. Specimen A—Dorsal posture. Anterior inferior view of cast filled rectum and lower sigmoid.

Fig. II. Specimen A—Dorsal posture. Left lateral view of paraffin filled rectum and lower sigmoid.

Fig. III. Specimen A—Dorsal posture. Right lateral view of cast filled rectum and lower sigmoid.

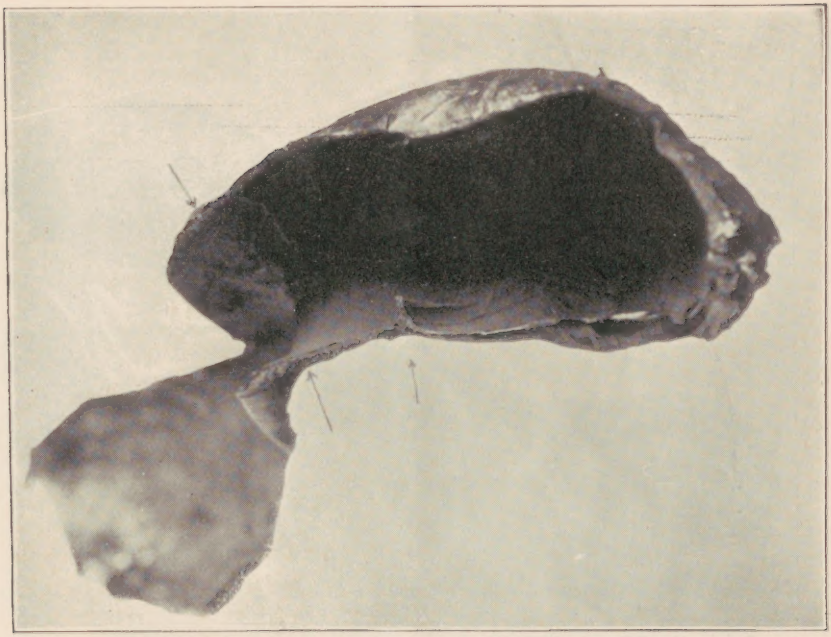

Fig. IV. Specimen A—Knee-chest posture. Right lateral half—interior view of rectum. Sigmoid out of focus.

Fig. VI. Specimen A—Knee-chest posture. Left lateral half—interior view. Upper rectum and sigmoid out of focus.

Fig. V. Specimen A—Knee-chest posture. Left lateral half—interior view. Anal region somewhatout of focus.

almost invariably detect, in place of the lax folds, what still seems to be an annular constriction, but which a more careful examination will show to be composed of two distinct semicircular bands slightly overlapping each other, the posterior being somewhat higher than the anterior."

Chadwick continues: "Being familiar with the views of Nelaton, Hyrtl, and others, I at first sought to assign to this apparent constriction of the rectum sphincteric functions, but soon had to relinquish that idea, for the exploration of very many *recta in the living failed to reveal a single one in which the lumen of the supposed sphincter, when quiescent, had a smaller diameter than three quarters of an inch, while in the majority it was over an inch.*

"These anatomical and clinical observations all tend to indicate that the term '*Third Sphincter Ani,' applied by Hyrtl to these constricting bands, is a misnomer*, and to show that they are simply a part of the general circular layer of muscles, whose function is to dilate before and contract behind the scybala, thereby propelling them on their way and not retarding them."

Chadwick closes by saying: "Having seemingly elucidated the true function of the 'Third Sphincter Ani,' and proved by the above observations that it should more properly be termed a *Detrusor Fœcium*, if deserving of any special appellation, my attention was next directed to the action of the internal sphincter."

Kelsey,* 1893, in a somewhat exhaustive discussion of this subject, says: "It is now about half a century since Nelaton first described the third sphincter muscle, and, in spite of all that has been written concerning it since that time, it is only a few years since Van Buren characterized it as an organ to which anatomy and physiology had been equally unsuccessful in assigning either certainty of location or certainty of function. For the original description of the muscle by Nelaton we are indebted to Velpeau, who writes that he has verified the existence of a sort of sphincter of the rectum, lately discovered by Nelaton, and goes on to say that it is *a muscular ring situated about four inches above the anus*, just in the place where retractions of the rectum are most often found. *If, after turning the rectum so that its mucous surface is external*, it is moderately distended by inflation, the muscles will be seen to be made up of fibers collected into bundles.

*Diseases of the Rectum and Anus, 1893, page 26. Wm. Wood & Company, New York.

"Sappey admits its frequent existence, and locates it at the level of the base of the prostate, in the middle portion of the rectum, six, seven, eight, or sometimes nine centimeters from the anus. It never completely surrounds the rectum, but only one half or two thirds its circumference; and it appears to him to be caused by a grouping of the circular muscular fibers. Its breadth is one centimeter, and its thickness two or three millimeters. Situated sometimes in front, sometimes behind, and again laterally or antero-laterally, it is constant in nothing except its direction, perpendicular to the axis of the bowel. In place of one he has sometimes found two bands at opposite points and different levels, and in one specimen there were three. Henle adopts Sappey's description in the main. Petrequin found the *muscle* irregularly oblique, less marked in the front wall than in the back, and consisting of a collection of weak bands of fibers."

After these quotations Kelsey comments as follows: "*The third sphincter muscle and the valves of mucous membrane in the rectum are not, as might be supposed, one and the same thing, though it is true that they have become almost hopelessly confounded in surgical and anatomical literature*, and are often spoken of as identical. The valves of the rectum (*we use the word simply as expressing the folds of mucous membrane*) were first described by Houston at about the same time that Nelaton described the superior sphincter; and it is worth remembering that the two authors *were writing about two entirely different things, and two things which stood in no necessary relation to each other, so far as we may judge from their descriptions.*

"According to this first and clearest of all descriptions,* for the whole article (Houston's) is written with a force and clearness of style which have perhaps had an undue weight in disarming criticism as to the facts, the valves exist in all persons, but vary much in different individuals as to location and number."

Kelsey quotes Houston's description (which has already been quoted by me), and in contravention says: "The palpably weak points in Houston's article were very soon pointed out by O'Bierne (1833) in a work of marked and almost amusing originality. O'Bierne seems rather to regret that he is unable to accept Houston's statements as to an anatomical condition which would account so fully and so easily for the physiological

*Kelsey, page 28.

emptiness of the rectum and fullness of the sigmoid flexure on which his (O'Bierne's) own views depend; but nevertheless he sets himself to the task of demolishing them with great vigor and considerable success. Although he believed the rectum to be normally empty, except just at the time of defecation, he believes that condition to depend upon the anatomical arrangement of the sigmoid flexure, joined with the narrowing of *the upper end of the rectum, which is entirely independent of any folds of mucous membrane.* He not only denies the existence of any such folds, but states flatly that Houston is altogether incorrect in his statement that Cloquet or any other anatomist before his (Houston's) time makes even the slightest allusion to them. He (O'Bierne) believes the folds to have been produced by the method of making the preparations, distending and hardening all parts with spirit before making the incision, and asserts that this method is any thing but natural, and nothing more or less than an attempt to exhibit natural appearances by placing the parts in an unnatural situation—such a situation, indeed, as is not known to be necessary for the exhibition of the valvulæ conniventes or any other valve of the body. *He* (O'Bierne) *meets the statement, that by the ordinary procedure of distending the rectum after removal from the body the valves are made to disappear, by the question, why, if such valves really exist, and if muscular fibers enter into their structure, they should not be discoverable at any time after death, or in any state of the intestine—a question very difficult of solution.*"

Kelsey, continuing further, says: "Four years later (1837) the voice of a New York surgeon was raised against these folds, and in almost the same language as O'Bierne's, though from an entirely different standpoint. Bushe declares that he has never, in the living body, been able to detect any valve of such firmness, and capable of exerting any such influence upon the descent of the feces as Houston describes, though he has frequently met with accidental folds produced by the partial contraction of the bowel. He (Bushe) points out that, by *the method of hardening the rectum after distending it with spirit, the accidental folds are rendered permanent by the induration resulting from the action of the alcohol; and that, by the method of inflating and drying, the projections resembling valves are produced by the angles formed by the setting of the intestine during the process of desiccation.*"

Kohlrausch locates one important fold, the plica transversalis recti, at the same point that Houston locates the most constant of the valves, projecting well from the right side of the bowel, forming a little more than a semicircle and running farther on

the anterior than on the posterior wall. Kohlrausch says that this fold is known as the sphincter ani tertius, though he does not think that the anatomical conditions justify the title, *as the circular muscular fibers do not enter into the structure and are not developed more here than elsewhere.*

Sappey describes the bowel in its empty state as presenting various folds of mucous membrane, having no determinate direction and but slightly marked. Of thirty recta examined he found but three that answer at all to Houston's chief valve or Kohlrausch's plica transversalis recti. *He says that there is no proof that these folds persist when the rectum is full, but that they probably are effaced by distension, and that it is an abuse of language to apply the name valve to them.*

Henle says that there is but one permanent valve, the plica transversalis recti, which is present only in a minority of subjects.

Rosswinkler locates and describes two folds, but locates them differently from several of the other authorities.

The elaborate investigations on the cadaver by Otis led him to say that the rectum consists of large saccular dilatations marked off from each other by intermediate partitions or folds, projecting alternately from left to right, one beyond the other. And, agreeing with Houston, he says that these partitions or folds are semilunar in shape, involve rather more than one half of the circumference of the internal surface, extend a little farther on the anterior than on the posterior wall and project at the center, where they are deepest, from one to two-and-one-half centimeters into the lumen of the bowel. The number of visible folds of this kind found by him was always two or three, two of which were constant, the other variable. He also locates these valves as did Houston, and continues: "The folds described within the bowel are *composed of mucous membrane and bands of circular muscular fiber in greater or less proportions.* The longitudinal fibers do not enter into the construction of the folds."

Kelsey comments on Otis' report as follows: "Excepting this description of the arrangement of the muscular fibers and folds of mucous membrane is more exact and definite than any previously given, and as to this constancy of location my own observation does not lead me to entirely agree, the author's conclusions from his dissections are *not different from those of other writers.*"

Mathews,* 1893, says: "Mr. Houston described some *ineffaceable* folds, which have received the name of Houston's semilunar

*Diseases of the Rectum, Anus, and Sigmoid Flexure, page 37. D. Appleton & Co., New York.

Fig. VII.—Specimen A—Knee-chest posture.—Left lateral half—interior view.

Fig. IX. Specimen B—Right half pictured on the left and the left on the right—very moderate distension.

Fig. VIII. Specimen B—Posterior view of rectum cut in lateral halves, replaced and pinned to its cast—very moderate distension.

Fig. X. Specimen G. Posterior view, gut cut in median halves and pinned to its cast. Moderate distension.

Fig. XI. Specimen G.—The right half on the left and the left shown at the right. The uppermost valve shown on the right is a half inch higher than its fellow. Moderate distension.

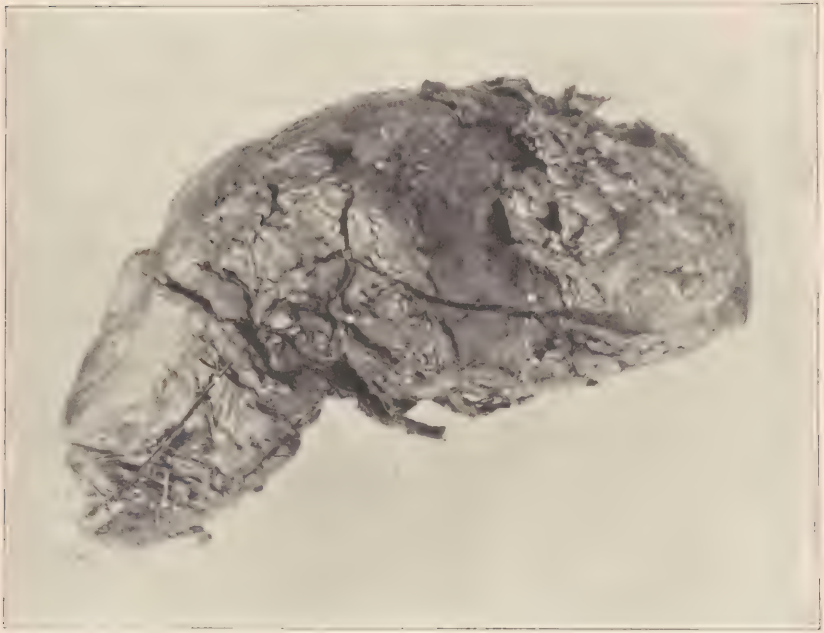

Fig. XII. Specimen D—Posterior view

Fig. XIII. Specimen D—Left half.

valves. That the student may have an opportunity of looking for them I will give the location where it is said they can be found." Quotes Houston's statements of their location, adds that it is claimed by Houston that their use is to support the fecal mass, and continues: "I have been thus explicit for the reason that I deny their existence, and if they did exist I would deny that their use is 'to support the fecal mass.' For many years I have searched for these folds and have yet to encounter them."

Mathews discusses the subject, and asks: "Is there a third sphincter muscle?" and answers that Kelsey, in his work on the Diseases of the Rectum and Anus, page 39, says: "From a study of the literature of this question, and from the results of dissections and experiments which we have been able to make, we are led to the following conclusions: (1) What has been so often and so differently described as a third or superior sphincter-ani muscle is in reality nothing more than a band of areolar muscular fibers of the rectum. (2) This band is not constant in its situation or size, and may be found anywhere over an area of three inches in the upper part of the rectum. (3) The folds of mucous membrane (Houston's valves) which have been associated with these bands of muscular tissue stand in no necessary relation to them, being inconstant and varying much in size and position in different persons. (4) There is nothing in the physiology of the act of defecation, as at present understood, or in the fact of a certain amount of continence of feces after extirpation of the anus, which necessitates the idea of the existence of a superior sphincter. (5) When a fold of mucous membrane is found which contains muscular tissue, *and is firm enough to act as a barrier to the descent of the feces, the arrangement may fairly be considered an abnormity, and is very apt to produce the usual signs of stricture.*"

Mathews then adds: "The only exception I would make to any of these is to No. 2, which says, 'This band is not constant in its situation or size.' I would beg to amend by saying that the band in many instances is entirely absent. I quite agree with all these conclusions of Kelsey, but would relegate the third or superior sphincter-ani muscle to the company of 'Houston's valves' and to the 'pockets and papillæ'."

Gant,* 1896, expresses himself as follows on this subject: "Internally the rectum presents three or four transverse folds. According to Houston the largest one is situated three inches (7.62 centimeters) above the anus," etc., quoting Houston;

*Diseases of the Rectum and Anus, 1896, page 10. The F. A. Davis Company, Philadelphia.

and in conclusion Gant says, "*The folds become almost obliterated when the bowel is distended.*"

After a very critical study of the methods heretofore employed in the investigation of this subject and of the results which have been obtained, and after considerable personal research made by means and methods original in character, I believe a survey of all the evidence before us will wholly reconcile the very numerous and diverse opinions concerning the matter.

It is not improper to assume that, if the judgment of trained observers be equal, their description of the thing considered will vary in the main, only as does the medium through which the view of each is obtained. Our critical review of the literature on this subject has revealed the two important facts, that observers employing like means of investigation adduce almost identical evidence, and that the more nearly the method of one approaches that of the other the more in accord are the conclusions reached. By the employment on both living and dead subjects of the methods used by the various observers, I have secured results which are practically and logically as harmonious as they have heretofore appeared contradictory, which proves that for a period of over sixty-five years these gentlemen have been discussing the same anatomical feature but from quite different points of view.

Houston distended and hardened the rectum *in situ* with spirit. On mesial section of the subject the gut presented valve-like folds with unvarying constancy but in varying number, and in different location in different subjects. He declared their structure to be a duplicature of mucous membrane and bundles of circular muscular fibers. Others, recognizing that in moderate distension the mucous membrane is loosely adherent in the lower rectum, insist that under the conditions employed by Houston the membrane would assume the same appearance in the upper portions as that described by him, and therefore conclude that these obstructions are accidental folds and not valves; and, as Houston did not support his statement by attributing to these valves the histological element which anatomists recognize as the essential feature of a valve, the opinion of his opponents is seemingly reasonable, but is nevertheless mistaken, as the mucous membrane of the upper rectum is more closely adherent to the muscular wall than is that of the lower rectum.

Hyrtl employed atmospheric distension after removal of the gut and observed an appreciable thickening of the wall of the rectum beneath the mucous membrane, and with apparent good reason assumed this thickening to be muscle only. Under the

Fig. XIV. Paraffin cast of specimen D—Posterior view showing a single valve mark above with two below.

Fig. XV. Specimen E—Posterior view of a specimen carefully dissected to show the muscular supply to the valve bases.

Fig. XVI. Specimen E—Anterior half.

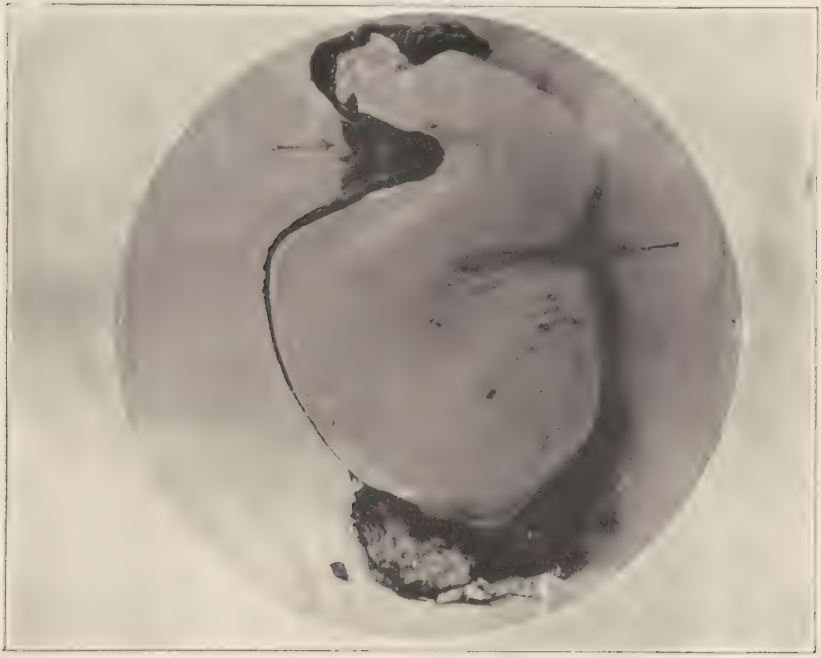

Fig. XVII. Specimen E—Posterior half occupied by its cast.

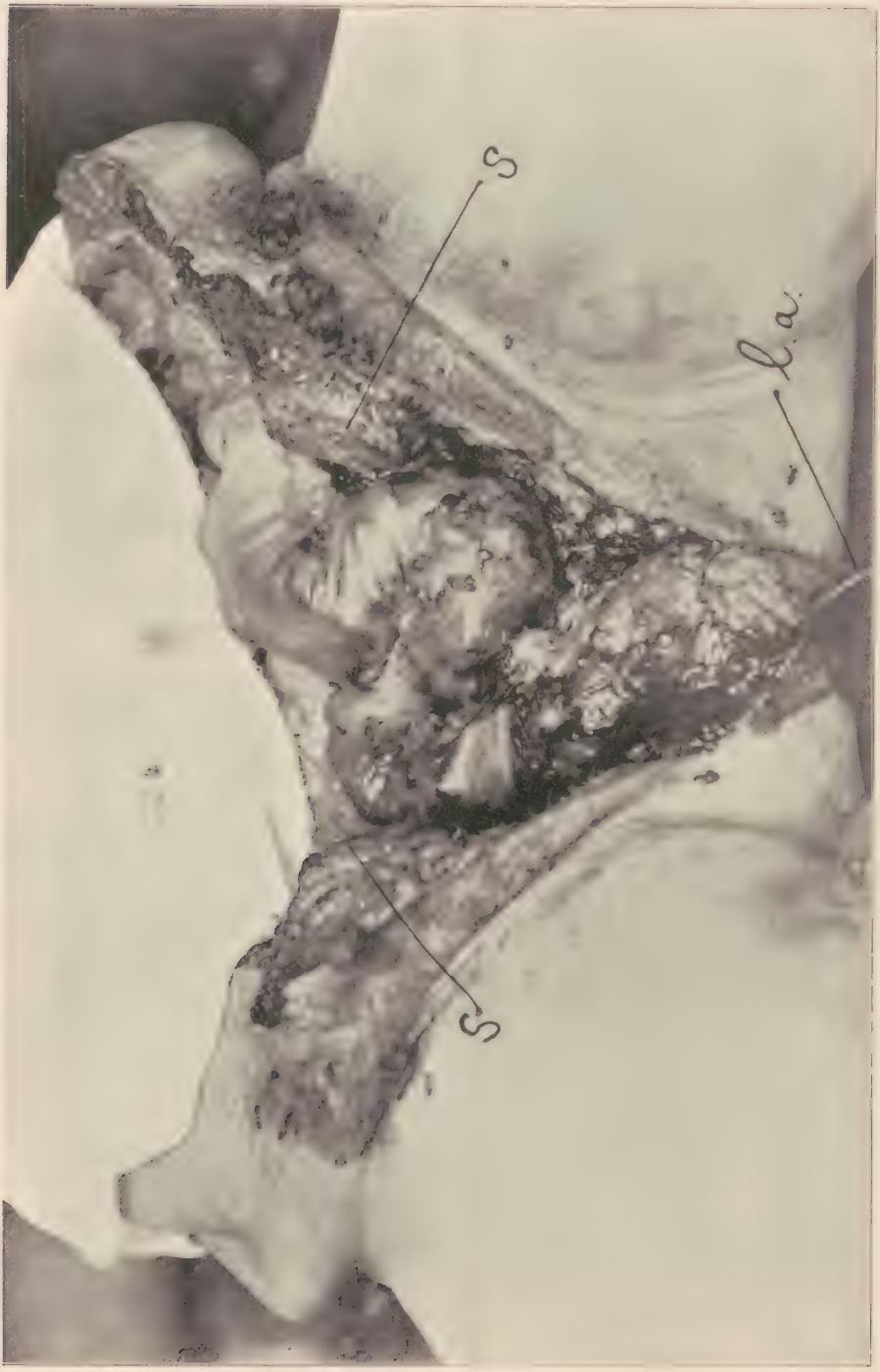

Fig. XVIII. Specimen F—Photograph of a female cadaver showing, after lapato-symphysotomy and removal of bladder, uterus and adnexa, the upper rectum and sigmoid packed with scybala; S S, symphysis pubes; l a, ligature at anus.

Fig. XIX. Specimen F. Amp., anal end of ampulla: s s, sigmoido-rectal communication; x x, x' x', a semilunar valve dividing the upper and middle portions of the rectum; m, the beginning of a semilunar valve on the right of the posterior wall; and m' m', the same valve continued over the anterior wall; b b, a small valve not prominent because of the empty state of the gut at this point; b, b', sigmoido-rectal valve; n, a portion of mesentery.

Fig. XX—A semilunar valve magnified fifteen times: A, mucous membrane; B, fibrous tissue; C, bundles of circular muscular fibers; D, vein; E, artery; F, vein; G, artery; H, areolar and adipose tissue.

same manipulations a valve may be made to lose its valvular character and seem to support this view.

Velpeau supported Nelaton's claim for the superior sphincter by removing the rectum and turning it inside out, so that its mucous membrane was external, and then by inflation demonstrated a marked constriction on the now external surface which was distinctly claimed to be nothing other than a muscular band. It is very easy to understand how the true valve of the normally situated gut would appear as a constricting band when the rectum is turned in the manner described.

Dr. Chadwick deserves the very highest praise for having discovered by digital exploration the lowermost of these valves, which he declared to be a detrusor fecium muscle instead of a valve. I find that these valves, when not the seat of disease, frequently elude the finger of average length or are inaccessible to it; and, as the uppermost is seldom less than five inches from the anus, this means of determining their presence is not usually a very practical or satisfactory one. This was very recently proven in a case in which the lowermost semilunar valve was malformed into a congenital annular or diaphragmatic stricture with a central aperture, which although within two inches of the anus escaped my digital perception and that of a dozen other medical men in attendance at my clinic and was not discovered until subsequently revealed by proctoscopy.

This anatomical feature of the rectum has been macroscopically examined by many investigators, but the macroscopical appearance as valves has been described only by Houston and, with perhaps a little more detail, by Otis. In the examination of more than a hundred living subjects I have found evidence to corroborate the testimony of these two investigators (Houston and Otis), and have compiled statistics from my cases to recount which would perhaps be wearisome repetition.

The method by which I first obtained a satisfactory view of the semilunar valves in the living subject was described by me in the July number of MATHEWS' MEDICAL QUARTERLY. By this method I observed that the more relaxed the circular coat of the gut—and therefore in proportion as the gut was distended—the more prominent were the valves. It was noticeable, also, that the more relaxed the muscular coat the more sharply defined were the valves' free borders; and, furthermore, that when muscular contraction occurred the active structure appeared to be confined to the valves' bases, because for the fleeting second before complete contraction of the tube, the free valve border

lost its taut appearance and hung relaxed and passive. In the history of this subject there is attributed but two structural elements to this hypsometric feature of the rectal ampulla: (*a*) that it consists of accidental duplicatures of mucous membrane, (*b*) that it consists of an aggregation of muscular fibres plus mucous membrane. It seemed to me that if the only histological element were mucous membrane that in the same degree as the rectum was distended an adventitious fold of mucous membrane would be effaced by distribution over an increased surface. The facts that muscular contraction relaxed the fold's free border, and that muscular relaxation sharpened the border as the rectum was atmospherically distended, were sufficient to hint at the importance of a microscopical examination to prove conclusively what was now conjectural.

The very natural manner of preparing the specimens for necroscopical examination was described in the paper mentioned. After a week's immersion in alcohol of the paraffin-filled gut the specimen was longitudinally divided into halves and the interior photographed. Subsequently sections were made of a number of valves from various subjects and microscopical evidence secured to establish the truth of my deduction. The drawing (Fig. xx) is pictorial testimony of what I believe to be a discovery, viz., the characteristic element of the semilunar valve of the rectum is the fibrous, almost tendonous band of tissue which occupies its free border and underlies the entire surface of the valve. The fibrous tissue characterizes the valve, the muscular tissue does not occupy its free border and is not its salient feature, although it is an important one. The arrangement of the blood-vessels in its base is evidence of especial provision for its nutrition.

The photographs demonstrate the presence of the obstructions under discussion; the sketch, which was drawn from the valve while under the microscopic lens, exhibits their character and proves it to be that of *a typical anatomical valve*, and the absence of any other such thickening of the wall in this gut is evidence that the semilunar valves and the so-called plica transversalis, sphincter ani tertius, superior sphincter, and detrusor fecium muscles are one and the same thing, and *that thing is essentially a valve*, which is most prominent when the gut is most distended.

791 Prospect Street.

AUTHORS QUOTED.—Bushe, Chadwick, Cloquet, Gant, Henle, Hyrtl, Houston, Kohlrausch, Kelsey, Mathews, Nelaton, Otis, O'Bierne, Petrequin, Rosswinkler, Sappey, Velpeau, Van Buren.